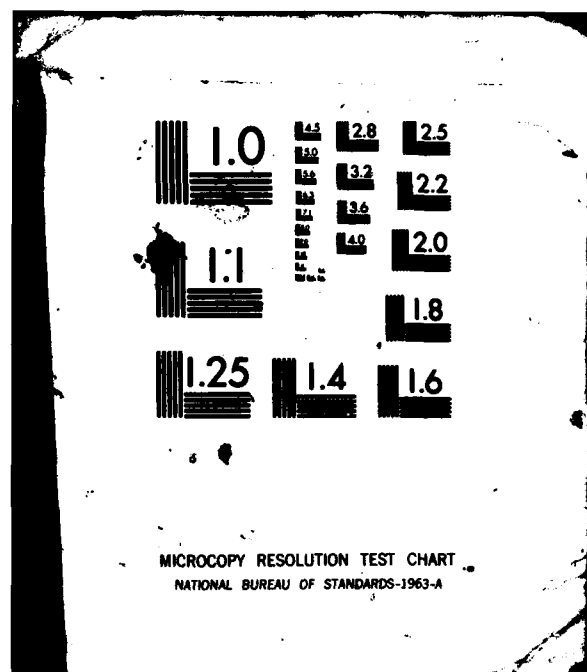
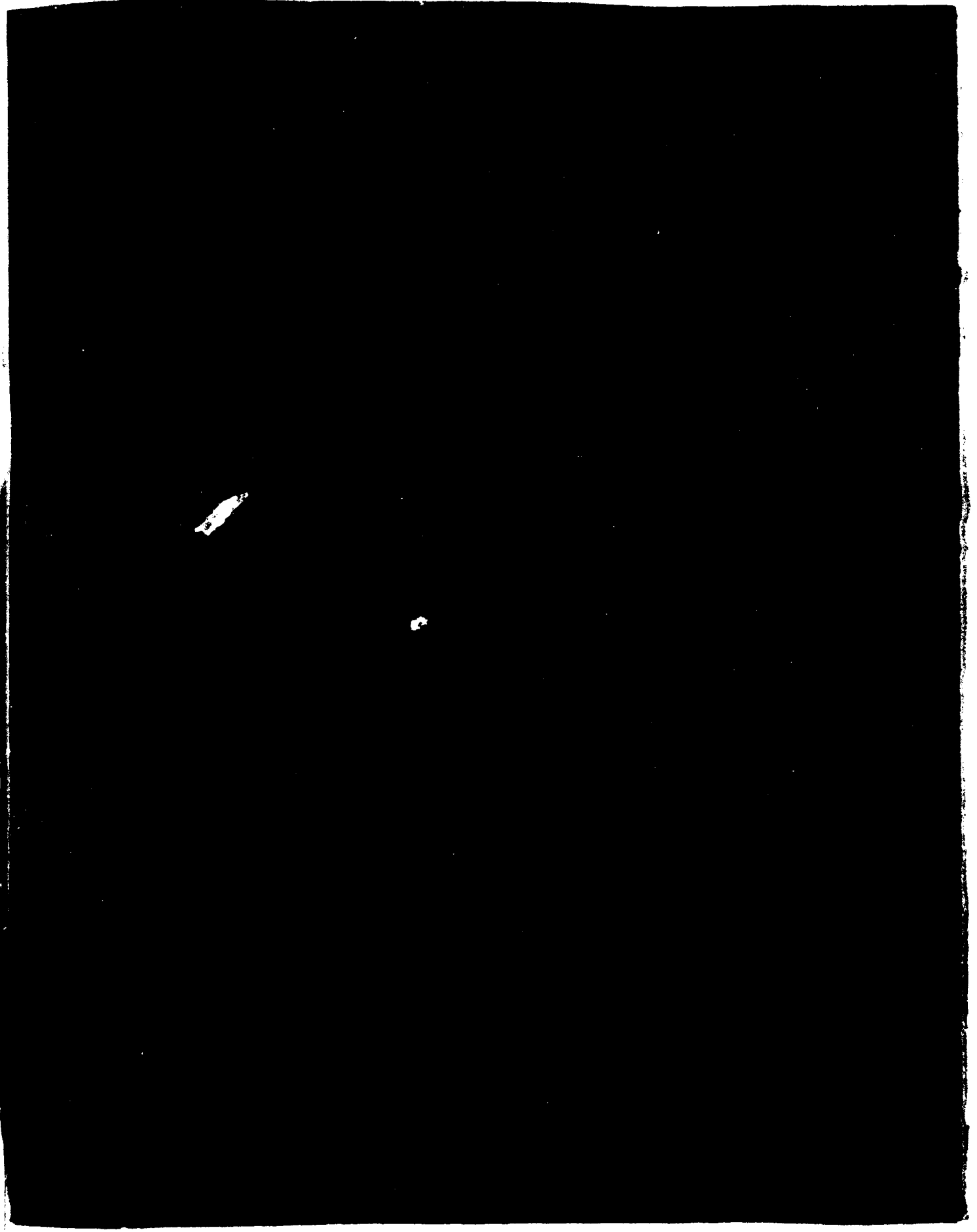


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USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK, VOLUME 162. MD-4MO G--ETC(U)
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The MD-4MO generator set is an electric motor-driven source of electrical power used primarily for the starting of aircraft, and for ground maintenance. This report provides measured and extrapolated data defining the bioacoustic environments produced by this unit operating outdoors on a concrete apron at a normal rated condition. Near-field data are reported for 37 locations in a wide variety of physical and psychoacoustic measures: overall and band sound pressure levels, C-weighted and A-weighted sound levels, preferred speech			

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interference levels, perceived noise levels, and limiting times for total daily exposure of personnel with and without standard Air Force ear protectors. Refer to Volume 1 of this handbook, "USAF Bioenvironmental Noise Data Handbook, Vol 1: Organization, Content and Application," AMRL-TR-75-50(1) 1975, for discussion of the objective and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc.

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PREFACE

This report was prepared by the Biodynamic Environment Branch, Air Force Aerospace Medical Research Laboratory, under Project/Task 723107, Measurement and Prediction of Noise Environments of Air Force Operations.

The author gratefully acknowledges Mr. John N. Cole for his assistance in preparing this report, Mr. Robert G. Powell for his assistance in acquiring the raw data, Mr. Henry T. Mohlman and Mr. Fred D. Lampley of the University of Dayton for their assistance in the mechanics of data processing, and Mrs. Norma J. Peachey who typed and prepared the graphics.

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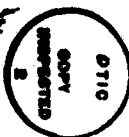


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NEAR-FIELD NOISE

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INTRODUCTION

The MD-4MO generator set is an electric motor-driven source of electric power used for the starting of aircraft, and for ground maintenance. This unit is manufactured by Teledyne Sprague Engineering.

This volume provides measured and extrapolated data defining bioacoustic environments produced by this unit. Such data are essential to evaluate ear protection requirements, limiting personnel exposure times, voice communication capabilities, and annoyance problems associated with operations of the MD-4MO generator set.

This volume is one of a series published by the Air Force Aerospace Medical Research Laboratory (AFAMRL) under the same report number (AMRL-TR-75-50) as a multi-volume handbook that quantifies the noise environments produced at flight/ground crew locations and in surrounding communities by operations of Air Force aircraft and ground support equipment. The far-field, community-type, noise data in the handbook describe the noise produced during ground operations of aircraft, ground support equipment, and other ground-based equipment or facilities.

Volume 1 of this handbook discusses the objectives and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc. Refer to Volume 1 (reference 1) for such information because it is not repeated in other handbook volumes.

A cumulative index lists those aerospace systems contained in the handbook, and identifies the specific volumes containing each type of environmental noise data available (i.e., inflight/flight crew and passenger noise, near-field ground crew noise, far-field/community noise). Volume numbers are assigned sequentially as individual volumes are published. This index is periodically updated as individual volumes are published and is available upon request from AFAMRL/BBE, Wright-Patterson AFB, OH 45433. Organizations on the distribution list for the handbook will automatically receive a copy of each updated index as it is generated.

Direct any questions concerning the technical data in this report and other handbook volumes to: AFAMRL/BBE, Wright-Patterson AFB, OH 45433; AUTOVON 78-53675 or 78-53664; Commercial (513) 255-3675 or (513) 255-3664.

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1. Cole, John N., *USAF Bioenvironmental Noise Data Handbook, Volume 1: Organization, Content and Application*, AMRL-TR-75-50(1), Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio, 1975.

NEAR-FIELD NOISE

MEASUREMENTS

A standard MD-4MO generator was operated outside in front of radar docks used for aircraft maintenance, on a concrete slab, at a normal rated condition. Due to the proximity of the radar docks, no far-field data were acquired.

Figure 1 identifies 36 noise measurement locations at a height of 1.5 meters above the concrete apron (nominal ear level of ground crew). The 0 degree reference direction passes through the tow bar. These locations are in the acoustic near-field of the source where the sound wave fronts generally do not spherically diverge and the source appears to be spatially distributed (i.e., not a point source). Consequently, these near-field data cannot be extrapolated to longer distances but do properly define the levels at locations close to the unit.

Near-field measurements were also made at ear level at the operator control panel. Table 1 lists the numeric/alphabetic designators used on the data pages in this report to identify the operator measurement location and test conditions. The designator 1/A means operator location 1 and test condition A. Such a descriptor is essential in many handbook volumes that involve multiple combinations of location/conditions. It is used in this report to maintain format consistency.

RESULTS

The measured data presented in Table 2 define the sound pressure levels (SPL) produced by the MD-4MO unit at 37 the specified, near-field locations. This table includes the overall, 1/3 octave band, and octave band levels. From these data one can calculate the variety of measures in Table 3 which are widely used to assess the effects of noise on personnel and their performance.

For data at other intermediate near-field locations (i.e., for radial distances less than 4 meters) you can interpolate between the 36 measured data points.

TABLE 1
MEASUREMENT LOCATIONS AND TEST CONDITIONS
FOR OPERATOR NOISE MEASUREMENTS

MD-4MO Generator
Tyndall AFB, 19 June 1980
FBN 0125-100-0079, Field #A101

Measurement Location	
1	Operator Control Panel
Operation	
A	Unloaded

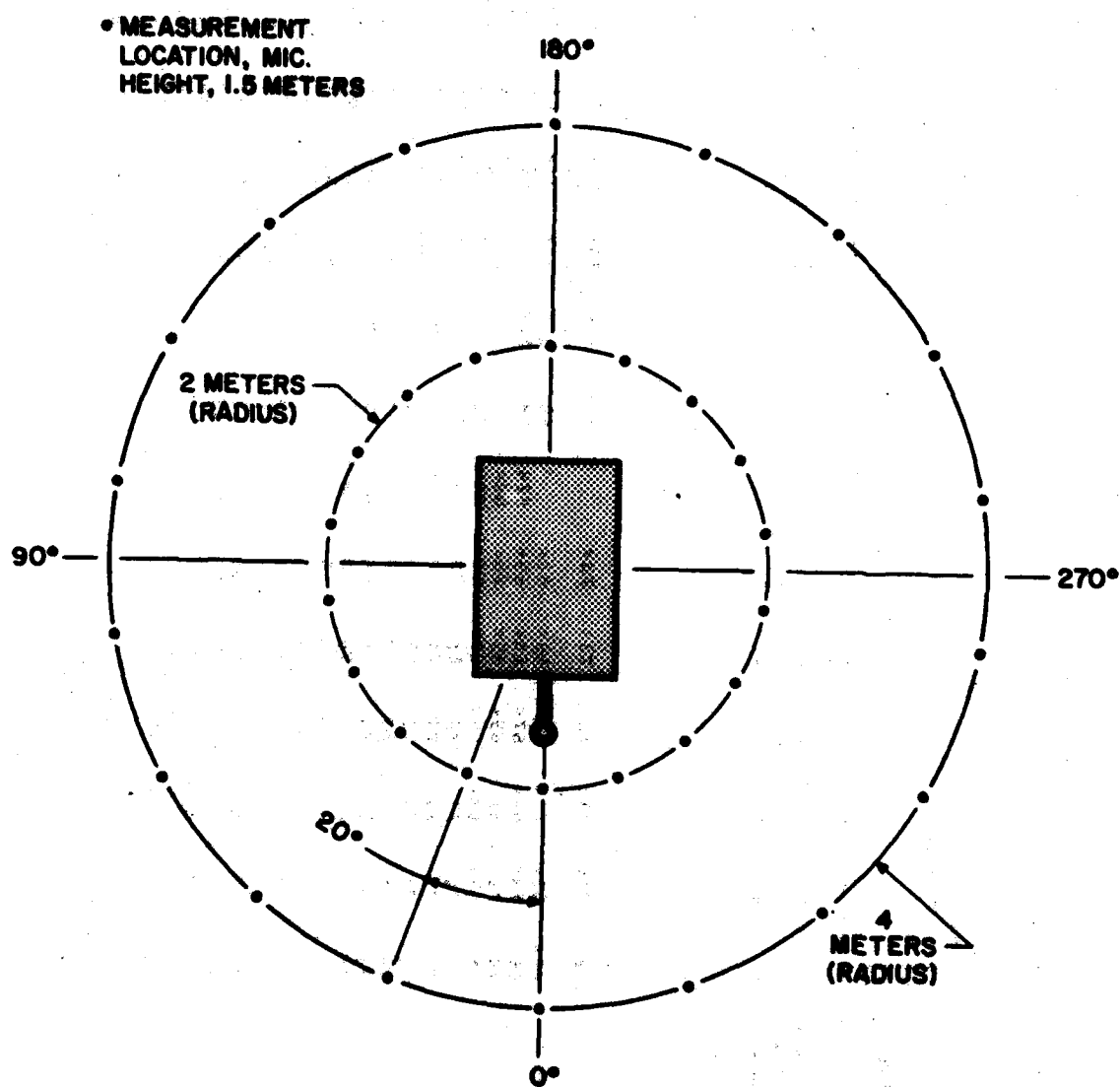


Figure 1. Measurement Locations

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)												
2 1/3 OCTAVE BAND												
IDENTIFICATION:												
NOISE SOURCE/SUBJECT: (OPERATIONS:)												
MO-4ND GENERATOR (UNLOADED)												
GROUND CREW ()												
NEAR FIELD NOISE LEVELS ()												
PAGE F1												
LOCATION/CONDITION												
FREQ	DISTANCE (M)-->	0	4	4	4	4	100	120	140	160	180	200
(HZ)	ANGLE (DEG)-->	0	20	40	60	80	100	120	140	160	180	200
	CONDITION-->	A	A	A	A	A	A	A	A	A	A	A
25												
31.5												
40												
50												
63												
80												
100		72										
125		70	F1	73	73	75	75		71	73	74	71
150				71						71	71	71
180		69	69	70	70	70	70	70	70	70	70	70
200		68	68	69	69	69	69	69	69	69	69	69
250		70	71	67	68	68	68	68	67	71	72	70
315		68	68	68	68	68	68	68	71	67	68	67
400		72	71	71	71	71	71	71	71	69	67	67
500		74	73	74	73	71	70	70	70	68	68	68
630		72	71	74	73	69	69	71	69	67	69	67
800		70	68	72	70	69	69	68	68	67	67	70
1000		68	68	70	70	68	68	68	68	68	67	70
1250		70	69	68	71	69	69	68	67	64	64	69
1600		68	64	68	68	68	68	64	62	68	68	68
2000		66	60	61	60	61	61	60	59	58	57	61
2500		59	59	61	60	60	60	59	59	57	58	60
3150		59	59	60	60	60	60	60	59	58	57	59
4000		59	59	59	57	56	56	56	56	53	53	54
5000		54	54	54	55	55	55	54	53	51	52	52
6300		52	53	52	54	53	53	52	52	50	50	51
8000		51	54	53	54	54	53	52	51	49	49	51
10000		48	52	53	51	49	49	50	48	46	46	47
OVERALL		63	61	62	61	60	60	70	68	68	61	68

* LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE 1 MEASURED SOUND PRESSURE LEVEL (DB)											IDENTIFICATION		
2 1/3 OCTAVE BAND											) OMEGA 3.2		
											) TEST DA-888-887		
NOISE SOURCE/SUBJECT:											) RUN 82		
NO-440 GENERATOR											) 06 APR 82		
GROUND CREW											) PAGE F2		
NEAR FIELD NOISE LEVELS													
LOCATION/CONDITION													
FREQ	DISTANCE (M)-->	4	4	4	4	2	2	2	2	2	2	2	2
(HZ)	ANGLE (DEG)-->	200	200	300	320	340	0	20	40	60	80	100	120
	CONDITION-->	A	A	A	A	A	A	A	A	A	A	A	A
25													
31.5													
40													
50													
63													
80													
100					75<						72<		
125		75<	73<	75<	73<	73<	74<	74<	73<	74<	74<	72<	
160				72<	71<			71<			71<		
200		69<	71<	71<	69<	69<	75<	75<	74<	73<	72<	70<	69<
250		68<	68<	68<	69<	68<	77	77	75<	73<	72<	69<	72<
315		69<	72<	70<	65<	69<	70	77	76	74	75	77	76
400		68<	68<	69<	70<	69<	75	75	76	70	76	76	77
500		70	69	70	73	73	73	76	76	73	73	73	71
630		70	70	74	75	75	76	77	70	77	76	74	75
800		70	70	73	73	70	70	77	76	76	76	75	74
1000		69	70	71	72	72	75	76	70	73	73	73	72
1250		72	71	69	72	71	74	74	75	74	75	75	72
1600		70	70	71	69	72	75	76	75	74	74	73	70
2000		67	66	67	64	64	70	69	70	70	70	68	66
2500		63	62	63	61	60	65	65	66	66	64	63	62
3150		62	61	62	61	61	64	64	65	65	64	64	63
4000		61	61	62	61	61	64	63	65	66	65	65	63
5000		50	50	50	50	57	61	61	62	62	61	61	60
6300		57	56	57	56	56	57	59	60	50	50	50	57
8000		56	56	57	55	55	55	57	60	50	57	50	57
10000		55	55	56	55	54	56	59	62	50	57	59	50
		52	51	52	52	52	53	54	55	56	53	55	54
OVERALL		81	81	83	83	82	86	86	86	86	85	85	84
< LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.													

< LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)											IDENTIFICATION:
2 1/3 OCTAVE BAND											
NOISE SOURCE/SUBJECT: (OPERATION:)											
NO-440 GENERATOR (UNLOADED)											OMEGA 3.2
GROUND CREW ()											TEST BA-888-887
NEAR FIELD NOISE LEVELS ()											RUN 83
											86 APR 82
											PAGE F3
LOCATION/CONDITION											OPERATOR LOCATION
FREQ	DISTANCE (M)-->	2	2	2	2	2	2	2	2	2	TEST CONDITION
(Hz)	ANGLE (DEG)-->	180	180	200	220	240	260	280	300	320	340
	CONDITION-->	A	A	A	A	A	A	A	A	A	1/A
25											
31.5											
40											
50											
63											
80											75<
100											79<
125		72<	73<	74<	73<	74<	73<	75<	74<	75<	81<
160			72<	71<	71<	71<	72<	71<	71<	71<	88<
200		69<	74<	72<	70<	70<	70<	72<	73<	74<	88
250		71<	73<	73<	69<	72<	69<	71<	73<	74<	79
315		73<	75	74<	75	75	77	75	77	77	79
400		73	72<	73	76	77	76	76	77	77	79
500		71	70	71	71	71	74	73	74	73	77
630		72	69	72	74	77	76	76	77	77	76
800		72	68	72	74	77	75	76	77	77	75
1000		69	68	70	74	74	76	75	76	76	74
1250		70	67	71	74	75	75	75	75	76	73
1600		60	66	68	73	75	76	76	74	73	72
2000		62	62	62	68	69	70	71	71	70	67
2500		60	58<	59	64	67	67	67	67	66	63
3150		59	58	59	64	67	66	67	67	67	62
4000		60	58	59	64	67	66	66	67	67	61
5000		56	55	55	61	63	62	62	64	63	59
6300		54	54	54	60	61	60	60	60	59	56
8000		51	51<	51	57	60	58	59	59	59	56
10000		51	52	50<	58	61	57	60	60	59	57
		48<	47<	48<	55	56	55	55	56	56	52
OVERALL		82	82	83	84	86	86	86	87	86	89

< LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

(TABLE: MEASURED SOUND PRESSURE LEVEL (DB)		(IDENTIFICATION:												
(2 OCTAVE BAND		(OMEGA 3.2												
(NOISE SOURCE/SUBJECT:		(OPERATIONS:										(TEST BA-888-887		
(MO-4MO GENERATOR		(UNLOADED										(RUN 81		
(GROUND CREW		(										( 86 APR 82		
(NEAR FIELD NOISE LEVELS		(										( PAGE J1		
((
		LOCATION/CONDITION												
(FREQ	DISTANCE (M)-->	4	4	4	4	4	4	4	4	4	4	4	4	4
((HZ)	ANGLE (DEG)-->	8	28	48	68	88	108	128	148	168	188	208	228	248
(	CONDITION-->	A	A	A	A	A	A	A	A	A	A	A	A	A
(
(31.5														
(63														
(125		78	73	76	74	74	75		73	76	77	76	73	76
(250		74	74	73	72	72	73	73	74	75	75	74	74	76
(500		77	76	76	76	74	75	76	74	73	73	72	75	77
(1000		74	74	75	75	74	74	72	73	78	78	71	74	75
(2000		67	66	67	67	67	67	66	65	63	63	63	67	69
(4000		61	62	62	63	62	63	62	61	60	59	61	62	66
(8000		56	57	57	58	57	57	60	55	53	53	55	58	60
(
(OVERALL		85	81	82	81	80	80	79	88	80	81	88	88	82

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)													IDENTIFICATION:	
2													OMEGA 3.2	
OCTAVE BAND													TEST 8A-888-887	
NOISE SOURCE/SUBJECT: (OPERATIONS:)													RUN 82	
MD-4MO GENERATOR (UNLOADED)													06 APR 82	
GROUND CREW ()													PAGE J2	
NEAR FIELD NOISE LEVELS ()														
LOCATION/CONDITION														
FREQ	DISTANCE (M)-->	4	4	4	4	4	2	2	2	2	2	2	2	2
(HZ)	ANGLE (DEG)-->	200	200	300	320	340	0	20	40	60	80	100	120	140
CONDITION-->		A	A	A	A	A	A	A	A	A	A	A	A	A
31.5														
63														
125		76	76	78	76	74	78	78	77	77	76	77	74	
250		73	74	74	73	73	81	81	81	80	79	80	80	79
500		75	74	77	78	78	81	81	81	81	80	79	78	79
1000		75	75	75	76	76	79	80	81	78	78	78	78	78
2000		63	68	69	67	67	72	71	72	72	71	71	70	69
4000		64	63	65	63	63	66	66	68	68	67	67	67	65
8000		59	59	61	59	58	59	62	64	62	61	62	61	61
OVERALL		81	81	83	82	82	86	86	86	86	85	85	84	88

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)											IDENTIFICATION:
2)
OCTAVE BAND)
											) OMEGA 3.2
											) TEST 9A-000-007
NOISE SOURCE/SUBJECT: (OPERATIONS )											) RUN 03
MD-4MD GENERATOR (UNLOADED))
GROUND CREW ( )											) 06 APR 82
NEAR FIELD NOISE LEVELS ( )											) PAGE 33
)
LOCATION/CONDITION											
FREQ	DISTANCE (M)-->	2	2	2	2	2	2	2	2	2	OPERATOR LOCATION
(HZ)	ANGLE (DEG)-->	160	180	200	220	240	260	280	300	320	TEST CONDITION
	CONDITION-->	A	A	A	A	A	A	A	A	A	1/A
31.5											
63											80
125		74	78	78	76	77	77	78	78	77	79
250		77	78	78	79	80	80	79	80	81	81
500		76	74	76	78	80	80	80	81	81	81
1000		74	72	74	78	79	80	80	79	80	81
2000		65	64	65	71	72	72	74	74	73	72
4000		62	61	61	67	69	68	68	69	69	67
8000		59	59	59	61	64	62	63	63	63	63
OVERALL		82	82	83	84	86	86	86	86	87	89

TABLE: MEASURES OF HUMAN NOISE EXPOSURE													IDENTIFICATION:
3													OMEGA 3.2
NOISE SOURCE/SUBJECT: (OPERATION:)													TEST BA-888-887
NO-440 GENERATOR (UNLOADED)													RUN 81
GROUND CREW ()													86 APR 82
NEAR FIELD NOISE LEVELS ()													PAGE H1
LOCATION/CONDITION													
DISTANCE (M)-->	4	4	4	4	4	4	4	4	4	4	4	4	
ANGLE (DEG)-->	0	20	40	60	80	100	120	140	160	180	200	220	240
CONDITION-->	A	A	A	A	A	A	A	A	A	A	A	A	A
HAZARD/PROTECTION													
C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN DBC) AT EAR													
A-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DBA) AT EAR													
MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73)													
NO PROTECTION													
OASLC	83	81	82	81	80	80	79	80	80	81	80	80	82
OASLA	78	77	79	78	77	77	76	77	76	74	75	77	79
T	960	960	960	960	960	960	960	960	960	960	960	960	960
MINIMUM QPL EAR MUFFS													
OASLA*	84	87	88	87	86	87	85	86	87	86	87	86	89
T	960	960	960	960	960	960	960	960	960	960	960	960	960
AMERICAN OPTICAL 1700 EAR MUFFS													
OASLA*	85	82	83	82	81	82	79	81	82	83	82	81	83
T	960	960	960	960	960	960	960	960	960	960	960	960	960
V-51R EAR PLUGS													
OASLA*	85	84	85	84	83	83	83	83	82	82	82	84	86
T	960	960	960	960	960	960	960	960	960	960	960	960	960
AMERICAN OPTICAL 1700 EAR MUFFS PLUS V-51R EAR PLUGS													
OASLA*	41	40	41	40	39	39	39	38	37	38	38	40	41
T	960	960	960	960	960	960	960	960	960	960	960	960	960
M-133 GROUND COMMUNICATION UNIT													
OASLA*	81	49	58	58	49	49	48	48	48	48	48	50	52
T	960	960	960	960	960	960	960	960	960	960	960	960	960
COMMUNICATION													
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)													
PSIL	73	72	73	73	72	72	72	71	69	69	69	72	74
ANNoyANCE													
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PHN)													
TONE CORRECTION (C IN DB)													
PNLT	90	88	89	88	89	88	90	87	86	87	87	88	91
C	1	0	0	0	1	0	3	0	0	1	1	0	1

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.

TABLE: MEASURES OF HUMAN NOISE EXPOSURE												IDENTIFICATION
3												OMEGA 3.2
NOISE SOURCE/SUBJECT: (OPERATION:)												TEST 8A-888-887
MO-4MO GENERATOR (UNLOADED)												RUN 82
GROUND CREW ()												06 APR 82
NEAR FIELD NOISE LEVELS ()												PAGE 02
LOCATION/CONDITION												
DISTANCE (M-->	4	4	4	4	4	2	2	2	2	2	2	2
ANGLE (DEG)-->	260	280	300	320	340	0	20	40	60	80	100	120
CONDITION----	A	A	A	A	A	A	A	A	A	A	A	A
HAZARD/PROTECTION												
C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN DB) AT EAR												
A-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DB) AT EAR												
MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 161-35, JULY 73)												
NO PROTECTION												
OASLC	81	81	83	83	82	86	86	88	88	85	85	84
OASLA	79	78	79	79	79	83	83	84	82	82	82	81
T	900	900	900	900	900	571	571	480	679	679	679	607
MINIMUM QPL EAR MUFFS												
OASLA*	90	90	90	90	90	90	90	90	90	90	90	90
T	900	900	900	900	900	900	900	900	900	900	900	900
AMERICAN OPTICAL 1700 EAR MUFFS												
OASLA*	92	92	94	94	93	97	97	97	97	96	96	96
T	960	960	960	960	960	960	960	960	960	960	960	960
V-51R EAR PLUGS												
OASLA*	94	94	95	96	96	99	99	99	99	99	99	99
T	960	960	960	960	960	960	960	960	960	960	960	960
AMERICAN OPTICAL 1700 EAR MUFFS PLUS V-51R EAR PLUGS												
OASLA*	94	94	94	94	94	96	96	96	96	96	96	96
T	960	960	960	960	960	960	960	960	960	960	960	960
M-133 GROUND COMMUNICATION UNIT												
OASLA*	91	91	91	91	91	95	95	96	96	96	96	96
T	960	960	960	960	960	960	960	960	960	960	960	960
COMMUNICATION												
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)												
PSIL	73	72	74	74	74	77	77	78	77	77	76	76
ANNOUNCE												
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PHDB)												
TONE CORRECTION (C IN DB)												
PNLT	89	89	91	90	91	94	95	95	94	93	93	92
C	0	1	1	0	1	1	2	1	1	0	1	0

* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.

TABLE: MEASURES OF HUMAN NOISE EXPOSURE											IDENTIFICATION:
3											OMEGA 3.2
											TEST BA-000-007
NOISE SOURCE/SUBJECT:											RUN 03
MD-4 NO GENERATOR											
GROUND CREW											06 APR 82
NEAR FIELD NOISE LEVELS											PAGE 03

END

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